Decadal Response of Soil Biogeochemistry to the Warming Climate of the Mojave Desert

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Considerable disagreement exists regarding how desert soil C will respond to changing climate. Here we examine the stocks of organic C and N, and the isotope composition, of Mojave Desert soils sampled in 1973 and 2018. The sites span an elevation gradient from 202 to 1605 m.a.s.l.

The climate in the area has warmed since 1970: mean annual temperatures have risen on average between 1.9-3.8°F depending on the station, and mean annual precipitation has declined at all but the highest elevation site. Soil organic C and N increases with elevation, though the mass per unit area is affected by gravel. In the upper 10 cm, C and N% increase with elevation, and 2018 samples are consistently lower than 1973 samples. C/N ratios increase with elevation, but 2018 samples are all 0.5 to 1.0 higher. The $\delta^{15}N$ value of the upper 50cm decreases by up to 4‰ with elevation, and 2018 samples are largely considerably more isotopically heavy than those collected in 1978.

All temporal differences are consistent with a reduction in soil organic matter due to changing temperature and precipitation regimes.. In support of this interpretation, we measured the bulk radiocarbon content of all soils. Using a two-pool steady state model (decadal and millennial pools), we calculated that the fraction of C in the active pool increases with elevation (from ~0.25 to 0.61) and the residence time increases from <5y to 50y, with the exception of one soil. The significant size of the active pools is consistent with the observed changes in C and N. Together, the radiocarbon-based residence times and the observed changes in concentration and isotope composition, appear to suggest that the Mojave Desert is now responding to anthropogenic impacts on the climate system.